Description: Making general sense of a(x+y) = ax + ay **Parent Tape: Early Algebra Ideas About Binomial Expansion, Stephanie's Interview One of Seven** **Date: 1995-11-08** **Location: Harding Elementary School** **Researcher: Professor Carolyn Maher**	**Transcriber(s): Aboelnaga, Eman** **Verifier(s): Yedman, Madeline** **Date Transcribed: Fall 2010** **Page: 1 of 4**

1		R1	Okay. Now. Do you see – Do you see how I convinced myself that that would always work?
2		Stephanie	Um hm.
3		R1	Do you see how I was trying to think if I was this little kid – you know how we would persuade a little kid that why if I doubled *x*, you get two *x*. What does doubling *x* mean?
4		Stephanie	Um hm. Right.
5		R1	Right? So why does this work? Multiplying *w* plus *l* times five?
6		Stephanie	Right?
7		R1	Are you convinced that will always work? That I – did I convince you that this is always going to work when I multiply by five.
8		Stephanie	Well, yeah. 'Cause I – uh, I mean I always thought, you know.
9		R1	I mean someone saying that's not a rule but – I'm saying that what *w* plus *l* means five times – it means that you have it five times.
10		Stephanie	Yeah.
11		R1	Alright, does that make sense?
12		Stephanie	Yeah.
13		R1	So suppose I asked you to convince me that why the Distributive Law works for eight times *w* plus the expression *w* plus *l*.
14		Stephanie	It's the same reason that it works for two.
15		R1	Right. What's that reason?
16		Stephanie	That you're simply taking that number and adding it with the same number the amount of times it's telling you.
17		R1	Okay. So the same time as two and the same time as five.
18		Stephanie	Um hm.
19		R1	And you would do eight the way – okay so that's not too bad if you know the number here: two or five or eight. So you think it will work for any number? Two, five, eight, eleven? Will it work the same way?

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20		Stephanie	I think so.
21		R1	Sixteen? – One million?
22		Stephanie	Yeah.
23		R1	Okay. So if I say any number…
24		Stephanie	Okay.
25		R1	Say "a".
26		Stephanie	Well that was – what you had here.
27		R1	So how would you convince me that it would work for say any number "a"?
28		Stephanie	That…
29		R1	If you have $(x + y)$ a times? How would how would you reason it in your head? How would you think about it?
30		Stephanie	That you're taking any number.
31		R1	Um hm.
32		Stephanie	And you're adding it with itself.
33		R1	Um hm.
34		Stephanie	as many times as a is.
35		R1	Okay.
36		Stephanie	Like…
37		R1	Yeah.
38		Stephanie	I'm trying.
39		R1	Okay. That's interesting. That's pretty neat. So um. Why don't you write that down? That's really kinda nice Stephanie what you just said. I just want to be sure you get a chance to think about it. You're going to try now to tell me what this is. *[$a(x + y) = ?$]* Okay? Why the distributive law works here. I'm interested in…
40		Stephanie	Um.
41		R1	Think about that for a minute and write it and I'll have a glass of water.
42		Stephanie	I – it just…
43		R1	Yeah just say it, just write what you've said.
44		Stephanie	Oh what I just said before.
45		R1	Sure, yeah.
46		Stephanie	That *[Stephanie writes "Your taking any number and adding it of itself the amount of times that the variable a equals"]* repeats what she wrote.

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47		R1	Okay. So what do you end up with when you've done that? When you've added *(x + y)* to itself *a* times?
48		Stephanie	Um.
49		R1	What do you end up with when you add *(x + y)*?
50		Stephanie	That –
51		R1	Do you end up with *a* times *(x + y)*?
52		Stephanie	Well –
53		R1	Is there another way you could say that?
54		Stephanie	Well – I would – I don't – *(x + y)*.
55		R1	See, I don't want to end up where I started. If I'm adding *(w + l)* to itself five times, I didn't end up with this *[5(w + l)]*. Do you see?
56		Stephanie	Um hm yeah. I understand. I just – I don't know how many times *a* is.
57		R1	But can you write an expression that says how many times in general? Without knowing it? - See when you knew it was two times, you knew how to write it. When you knew it was five times you knew how to write it.
58		Stephanie	We just –
59		R1	And we conjectured when it was eight times how to write it.
60		Stephanie	It would just be like *(x + y) = (x + y)* – I don't know – cause like here I don't have the –
61		R1	Okay. Well, how many times are you going to do this now?
62		Stephanie	As many times as *a* is.
63		R1	Okay. So write that down. *(x + y)* as many times as *a*. Okay now.
64		Stephanie	Oh, do you want me to say just *(x + y)* as many times as *a*?
65		R1	Sure. *[Stephanie writes.]*
66		Stephanie	Okay.
67		R1	Okay. Can you imagine this in your head?
68		Stephanie	Yeah.
69		R1	You got *(x + y)* as many times as *a*.
70		Stephanie	Okay.
71		R1	Can you imagine that?

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72		Stephanie	Well yeah. But I'm just imagining like any number.
73		R1	Tell me what's in your head when you see this.
74		Stephanie	Just like rows of *x*'s and –
75		R1	Rows of *x*'s – how many *x*'s would you end up with when you're all done?
76		Stephanie	Um. A lot.
77		R1	How many? If you're doing it – if you have *(x + y) a* times?
78		Stephanie	*a* amount of *x*'s.
79		R1	Right. And how many *y*'s?
80		Stephanie	*a* amount – like
81		R1	So why don't you write that down? Isn't that what it's going to be? How would you write *a* amount of *x*'s and *a* amount of *y*'s?
82		Stephanie	Um. Could I just write you would end up with *a* amount of *x*'s?
83		R1	Yeah. I'd like to see how you would write that. *[Stephanie writes: "a amount of x's + a amount of y's".]*
84		Stephanie	It's just like – like – It looks like this, only it's –
85		R1	Okay. So can you write it in a simple form? The *a* amount of *x*'s and *a* amount of *y*'s? What does *a* times the expression *(x + y)* now equal? If we want to replace this question mark, how could you write *a* amount of *x*'s and *a* amount of *y*'s?
86		Stephanie	*ax + ay*?
87		R1	Doesn't that make sense?
88		Stephanie	Um hm.
89		R1	Which is what you conjectured before.
90		Stephanie	Yeah.
91		R1	Based on – Does that make sense?
92		Stephanie	Yeah.
93		R1	You really believe it, right?
94		Stephanie	Yeah.